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ABSTRACT

This booklet is one of a set of learning modules on
 energy for use by students and teachers in the fourth grade. This
 module defines energy and examines simple machines. Laboratory
 activities and a values exercise are included. (BT)

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LET'S LEARN ABOUT ENERGY

Module A

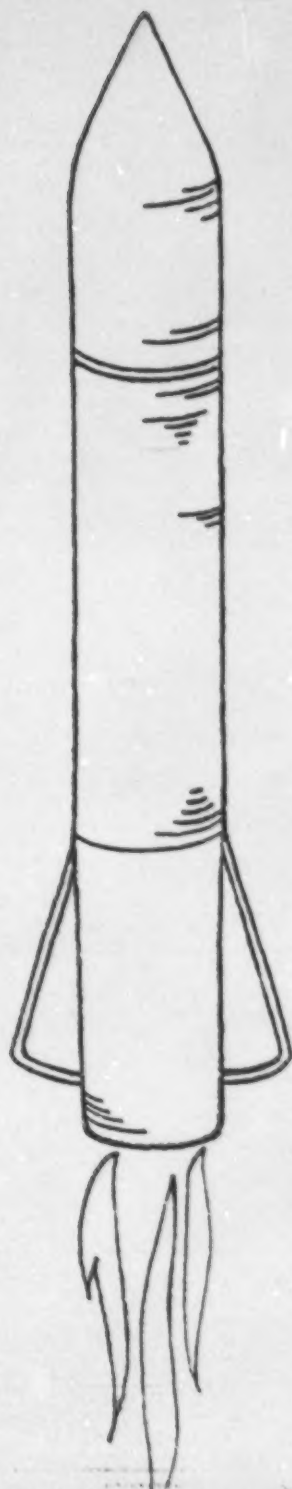
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INTRODUCTION:
ENERGY EDUCATION PROGRAM

You are about to begin a study of Energy. Recently, there has been a lot of talk about energy in the news. Have you wondered what energy is? Do you know why people are so concerned about energy? These and hopefully many other questions will be answered in your study.

Large amounts of energy are used in the world today. Energy is needed to run cars, planes, factories and farms. It is even needed in the form of food for us to live.

Energy is important to everyone.

During your study you will learn many things about energy. In this module you will define energy and discover its different forms. You will examine simple machines which make man's work easier, and learn how energy was used in the past.

Perhaps some of your questions will remain unanswered. Scientists still have many questions about the future of energy. Your study may help you find answers to some of the questions in the years to come.

ENERGY MANAGEMENT CENTER STAFF



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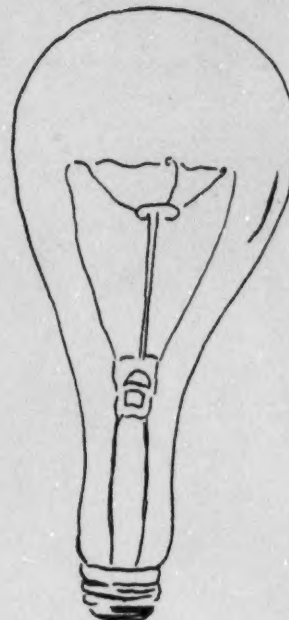
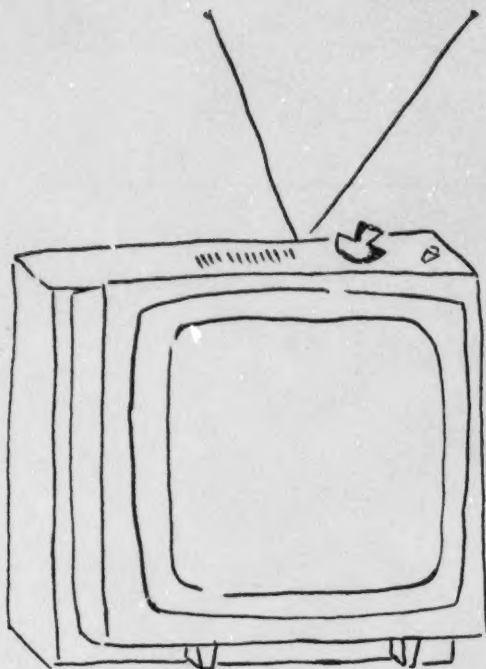
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THE NATURE OF ENERGY

What do you think of when you hear the word energy? Is energy something you can see or touch? You know that energy is needed to work or to play. It is needed to do any type of activity.





Energy is also needed for plants and animals to live and grow. _____ is being used all around us.

We must have energy in different forms to turn on lights, make the television work, or to run a car or an airplane.



Energy plays an important part in our everyday life. It is needed for everthing that takes place. Without energy in its many forms nothing would ever happen.

In order to understand the meaning of energy, we must first talk about work.

To some people work is learning spelling words or doing math. To others it is making the bed or mowing the lawn.

What does work mean to you?



For scientists, work has a special meaning. To them, work is done when force moves matter through a distance. Let's remember simply that W _____ is MOVING AN OBJECT FROM PLACE TO PLACE.

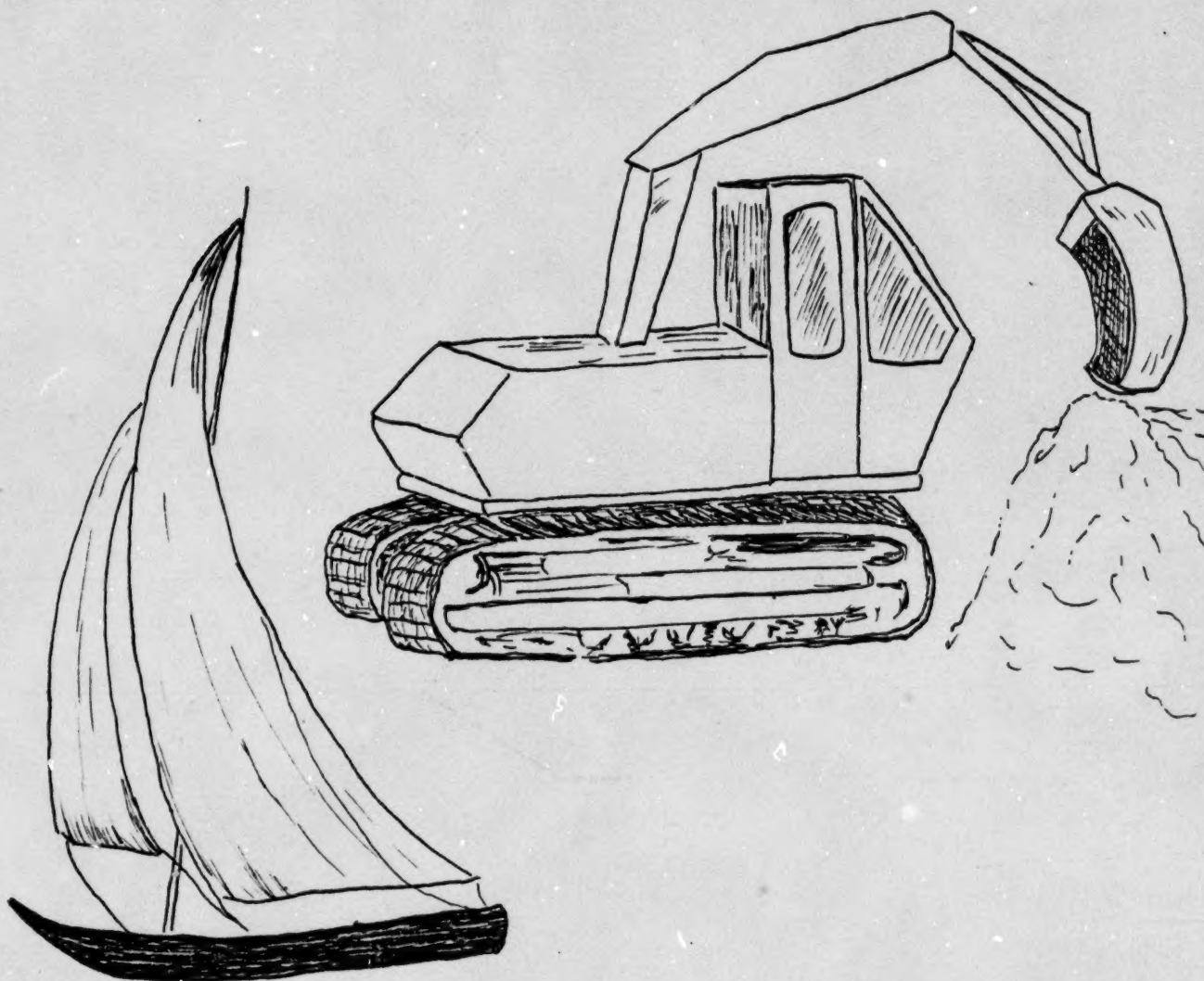
Mowing the lawn is work. In order to do this or any other work, energy must be used. Without energy, work could not be done. Therefore, we can say that ENERGY IS THE ABILITY TO DO WORK.

Think of some ways energy was used to do work before you came to school.

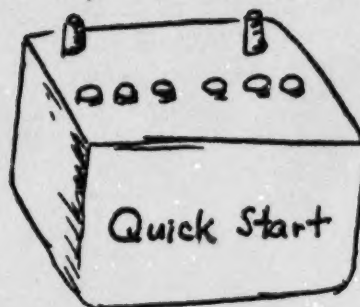


ENERGY IN MOTION

Were objects moving when the work was being done?
 Objects or matter in motion have energy. THE ENERGY
 IS IN MOTION. RUNNING WATER, BULLDOZERS MOVING SOIL,
 and SAILING A BOAT are some examples of energy in
 M _____.



Scientists' call energy that is in motion KINETIC
 (ki-net-ik) ENERGY. They say that moving matter has
 K _____ energy. What are some things
 you do that have kinetic energy?

STORED ENERGY

Energy is not always in motion. Energy can be stored. Can you think of an example of stored energy? A battery that runs a radio or starts a car has S energy. Gasoline which is used in an engine to do work also is stored energy.

Another name for stored energy is POTENTIAL (pə-ten'shal) ENERGY. A wound watch spring has P energy. It can do work as the spring returns to its original shape. Does a stretched rubber band have potential energy? Can it do work when it goes back to its original shape? Early man used a hunting tool which did work in this way. The tool was made of wood and string and had potential energy when the string was pulled back. What was it? What work did it do when it returned to its usual shape?

An object can have potential energy because of "where" the object is. For example, water at the top of a dam has potential energy (stored energy) because the water can do work when it falls. Does a boulder on the edge of a cliff have potential energy? You may not like the work it could do if it fell. In these examples, the objects have P energy. Can you think of other examples of potential energy that depend on where the object is located?

As you see, an object can have potential energy because of "what" it is (fuel) or "where" it is (boulder on cliff.)

REVIEW

Fill in the blanks below with information you have learned.

1. Energy is the ability to do W _ _ _ _.
2. Work is when you M _ _ _ _ objects from place to place.
3. Energy exists in two ways, energy in M _ _ _ _ and S _ _ _ _ energy.
4. Scientists call energy in motion _ _ _ _ energy.
5. Scientists call energy that is stored _ _ _ _ energy.

Look at each diagram on this page and the next page and decide whether each is an example of KINETIC ENERGY (energy in motion) or POTENTIAL ENERGY (stored energy). Write KINETIC or POTENTIAL in the blank below the picture.

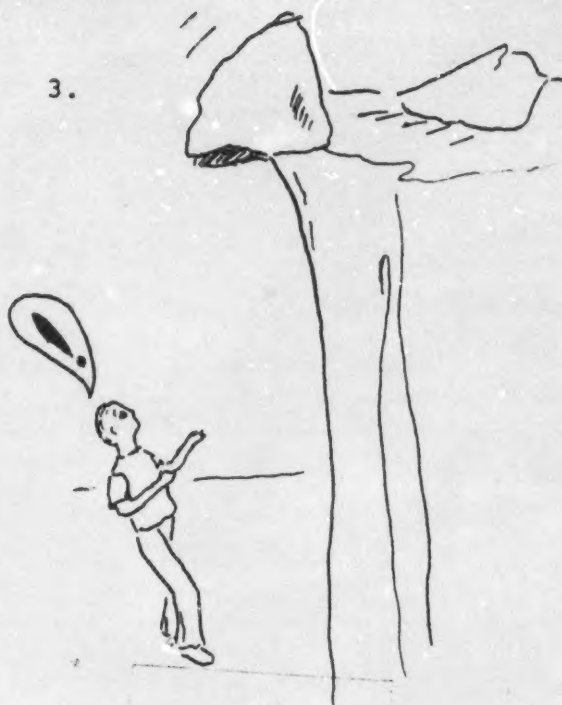
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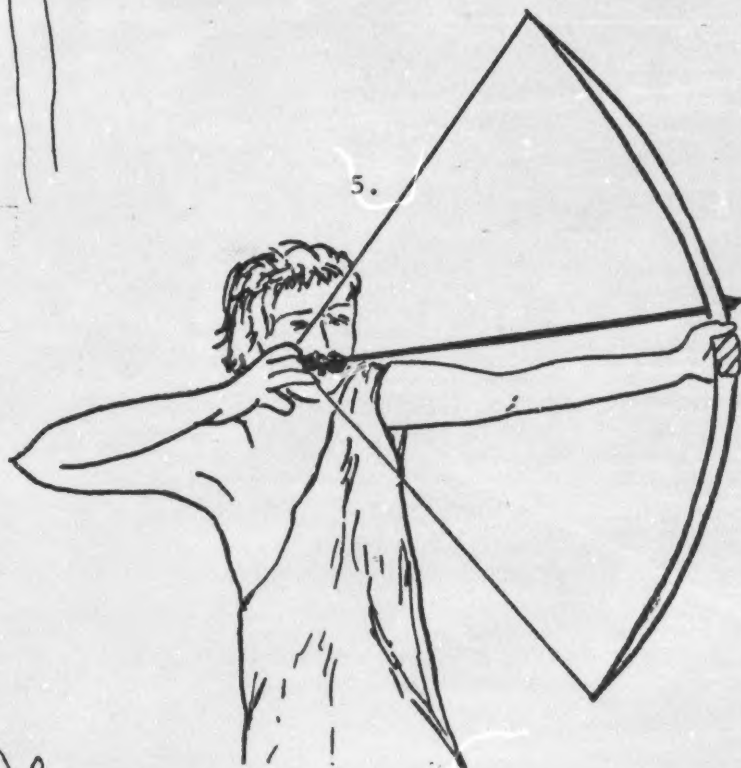
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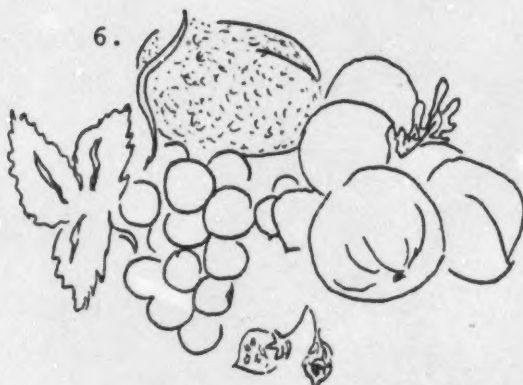
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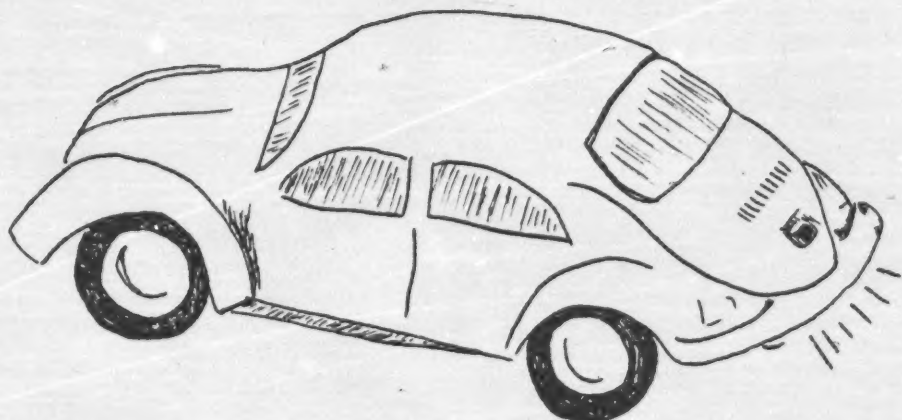


L.A.P. ONE FORMS OF ENERGY

Energy exists in many forms all around us. After reading this section, you will be able to recognize examples of mechanical, chemical, atomic, electric, heat, sound and light energy.

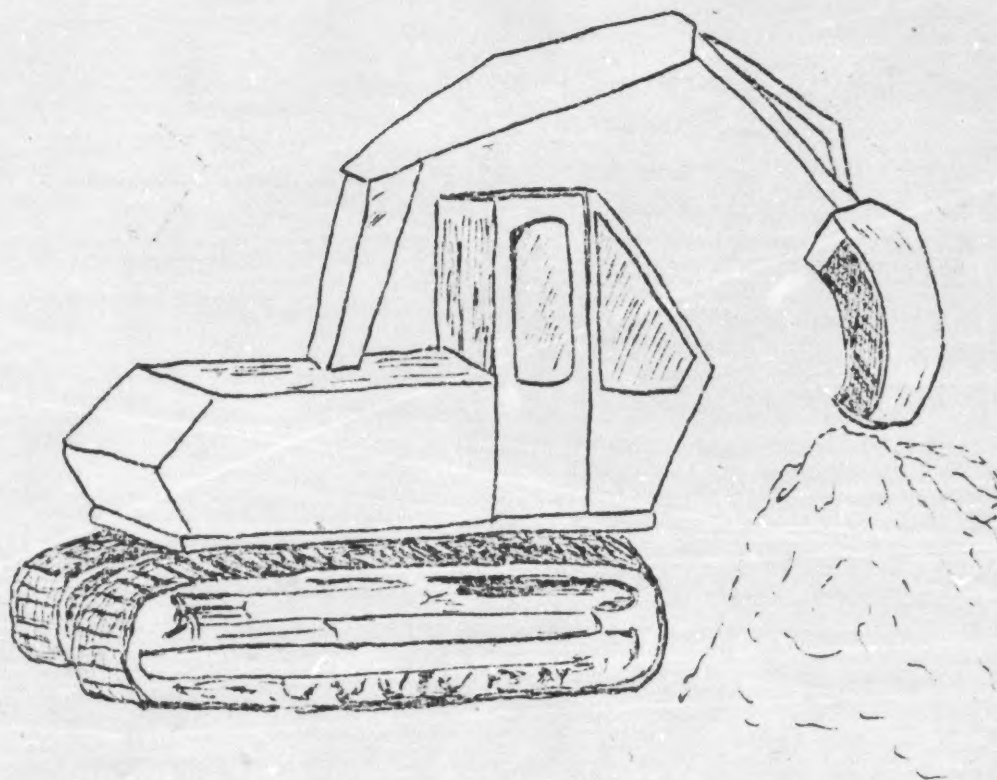
MECHANICAL ENERGY

Potential (stored) energy is changed into kinetic (motion) energy by machines. When kinetic energy is made by a machine, we call it mechanical energy. Mechanical energy is the energy of a moving object. A car engine is a machine that changes ONE FORM OF ENERGY INTO ANOTHER. Gasoline (potential energy) in the car makes the engine run. The engine does work by making the wheels turn. When the wheels turn, the car moves. The moving car has KINETIC ENERGY. This kinetic energy is called MECHANICAL ENERGY because the object is moving.

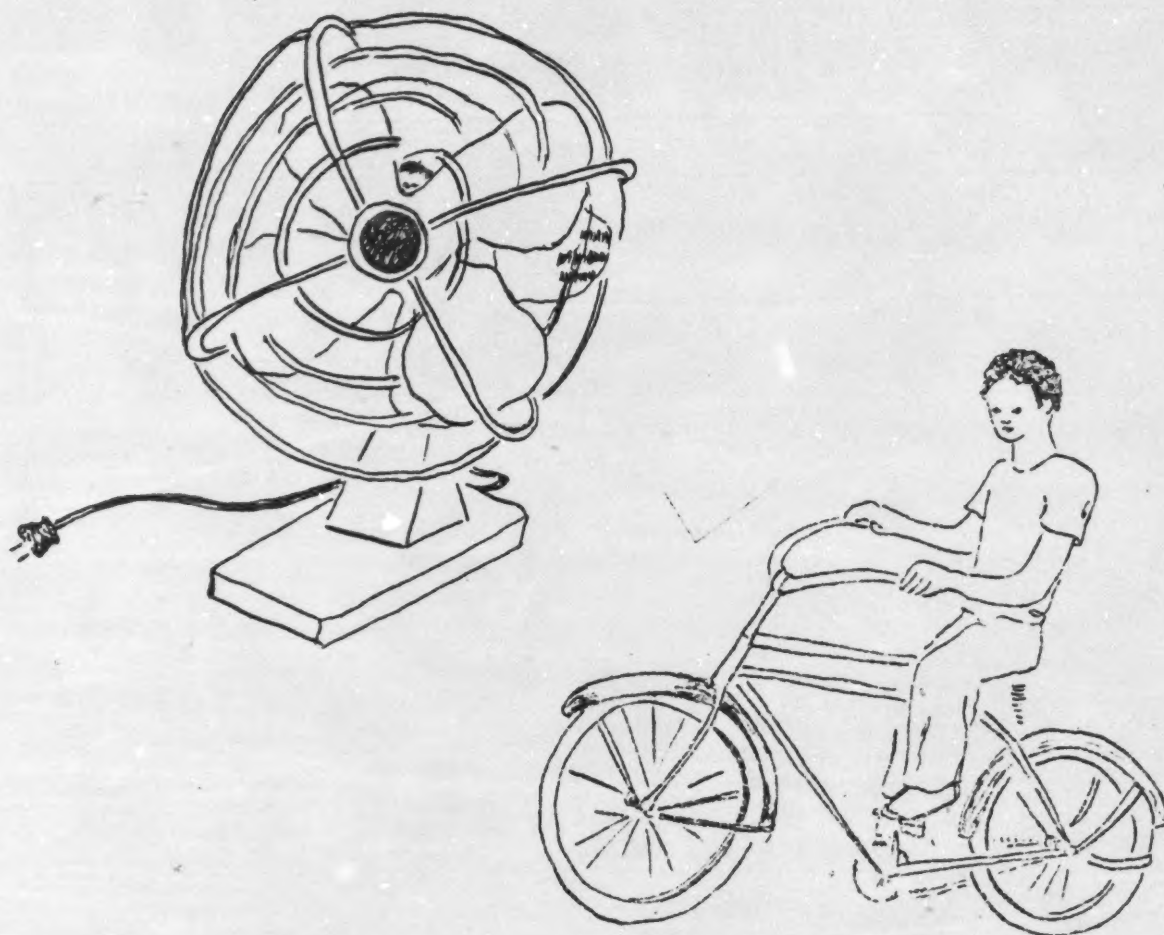


Here are a few pictures of machines that change potential energy into M E

Machines can have many parts or they can be simple.



There are also some machines that change motion of one kind into a different kind. That means one kind of kinetic energy can be changed into another kind. Here are some examples of these M _ _ _ _ _.



Remember, Potential and Kinetic energy can be changed from one kind to A _ _ _ _ _.

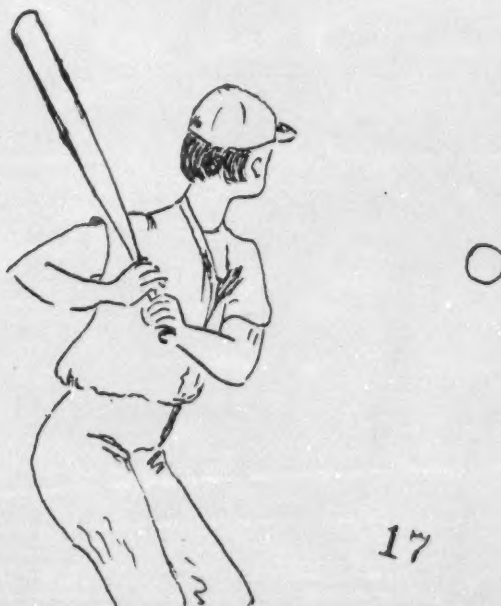
CHEMICAL ENERGY

Some POTENTIAL or STORED energy is found in gas, coal, oil and other fuels. It is called CHEMICAL ENERGY. Chemical energy is stored in tiny particles that are hooked together. The little hooks are broken apart by burning. When this happens ENERGY IS RELEASED.



A machine changes CHEMICAL ENERGY to MECHANICAL ENERGY.

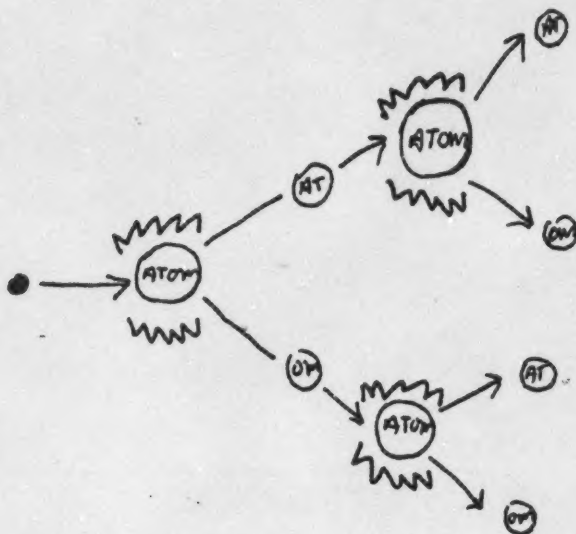
Did you know that you are a MACHINE! How is this true? Remember, a machine CH one kind of E into another kind. What is the fuel that makes you work? F d is right. Like gas for cars, food is your fuel. Food has energy stored in tiny particles that are hooked together. CH energy is released when the hooks are broken apart by digesting. As a machine then, you change food's energy into M Energy. How do you use this energy? You do WORK. —



ATOMIC ENERGY

You just read about tiny particles. They are hooked together in different kinds of fuels. We call the little particles ATOMS. When the hooks are broken
CH — — — — — ENERGY is released.

We get another kind of energy from atoms. We get it by cracking or splitting special kinds of atoms. This releases the energy of the atom. We call this energy ATOMIC ENERGY.



ELECTRIC ENERGY

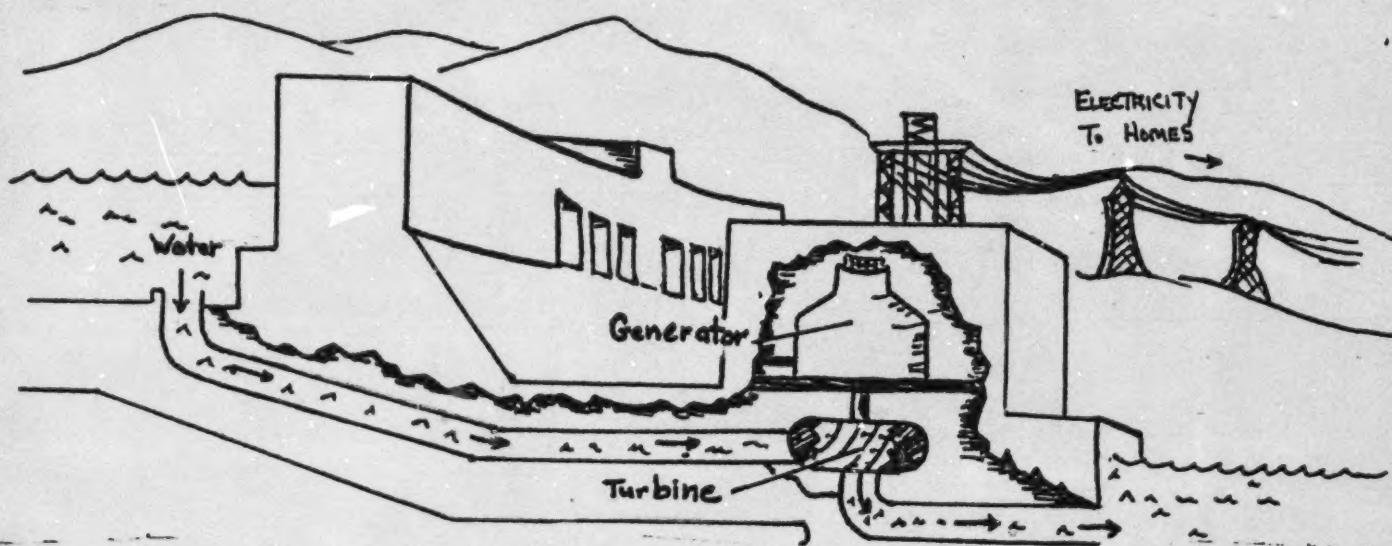
Electricity lights, heats and cools your home. It cooks your food. The manufacture of nearly everything you need for your way of life comes from E _____ ENERGY.

Electric energy comes from the movement of tiny particles. They are even smaller than atoms. We call them ELECTRONS (i-lek-trons). Because they are in MOTION these electrons can do W _____.

A dam with a WATER-POWERED plant is a MACHINE. It changes one kind of energy - (the motion of fast-moving water) to another kind of energy (the motion of electrons or electricity).



HOW ELECTRICITY IS MADE BY A WATER-POWERED PLANT



1. Fast running water from the dam puts the TURBINE (waterwheel) in MOTION.
2. The mechanical energy from the turbine runs the generator.
3. The generator changes the mechanical energy into electrical energy.
4. The electricity FLOWS through wires to your home.

Electrical energy can be made in many other ways. You will study many of them as you work with the Energy Management Center projects.

HEAT ENERGY

Rub your hands together. They become warm. If we sandpaper wood, the sandpaper and the wood become warm. "Floor burns" result from sliding on gym floors. A nail gets hot as it is drawn from wood. In fact, when any two objects are rubbed together heat is produced. Thus, the energy which is used in rubbing is converted into heat. Any energy that is changed gives off H _____. That is why any change in energy never returns the same amount of energy that was used. For example, you do not get 100% of the energy from your food because some of that energy is lost in heat. When you get too hot you cool down your heat energy by perspiring (sweating).



Heat comes from many things. The major sources of heat come from chemical changes. Burning, electricity, atomic reactions, and the sun provide heat energy. When molecules of liquids or gases are heated, they start moving faster and faster. These moving molecules have K _____ ENERGY.

SOUND ENERGY

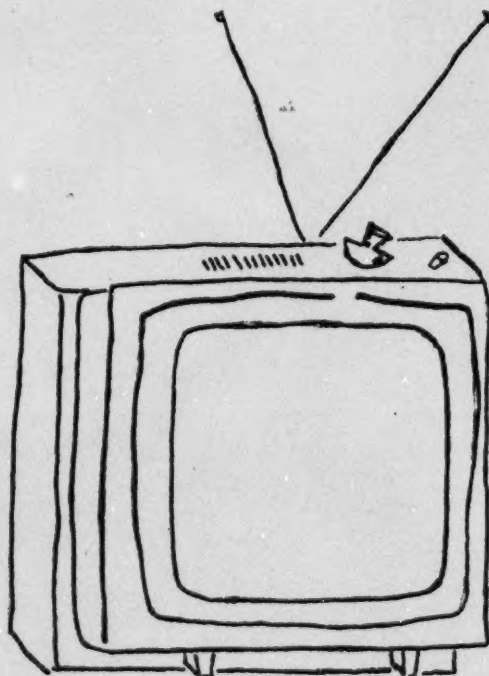
Sound is a form of E _____. We know from experience that it is necessary to do work (of some sort) to make sound. We must blow a trumpet or whistle, strike a piano key or a drum. Even in singing we must blow out our breath with force.

Sound is a back and forth motion (vibration) of an object. This vibration moves the air or any other substance. Since sound is a movement of the air, it is a form of kinetic or M _____ ENERGY.

LIGHT ENERGY

Light is a form of radiant energy. Other forms of radiant energy are radio and television waves, ultraviolet rays, and x-rays. Most of our light comes from the S ____.

But light can come from other sources too. Light energy travels in straight lines. Light is made of wave lengths. These waves of light have K _____ ENERGY.



L.A.P. ONE
ENERGY ACTIVITIES SHEET

1. Your teacher will be showing you a filmstrip called "Where Energy Comes From and Where It Goes." You have learned about the forms of energy. What are they? As you watch, look for examples of these forms. Notice that the filmstrip uses examples of man's early uses of energy as well as those of today.

2. Match the phrases on the right with the example it represents on the left. Write A or B in each blank.

- | | |
|----------------------|---------------------|
| ___ 1. Walking | |
| ___ 2. Gas Tank | |
| ___ 3. Water Faucet | |
| ___ 4. A Fire | A. STORED ENERGY |
| ___ 5. A Battery | B. ENERGY IN MOTION |
| ___ 6. Falling Stone | |

3. Circle the words that are forms of energy. Words read left to right; right to left; up or down; diagonally.

M A I E G M Y O G J

E L E C T R I C A L

C J B D A F K F T H

H A N H E L P N O I

A C R O H X P U M P

N R K Z P T H G I L

I S A Q T C R L C R

C U O V E N Q E M T

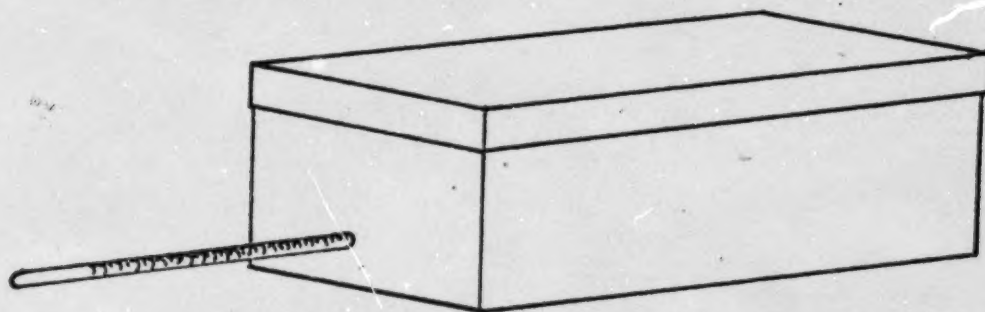
A B V E D S V U E W

L A C I M E H C A N

4. Make a collage from pictures in a magazine with examples of the different types of energy.
5. Look at all the appliances in your house. Make a list of all the ones which use ELECTRICAL energy, then the ones which use CHEMICAL energy, then HEAT energy and last MECHANICAL energy.
6. Make a sun box heater. Here's what you need:

A Shoebox (without a cover)
 Two Thermometers
 Clear Plastic Wrap
 Aluminum Foil
 Tape

Here's what you do: Make a small hole in the side of the box for the thermometer. (See drawing below). Line the inside of the box with foil. Stretch plastic wrap over the top of the box. Tape it down.



Put one thermometer somewhere in the sun. Put second thermometer (bulb end first) in your sun box. Make sure the see-through top faces the sun. Check temperatures of both thermometers in one-half hour. Which is higher? Why?

7. Making a string telephone. Get two cans of the size in which vegetables are sold. Remove the tops of both and punch a small hole in the bottom of each can. Take a piece of string about ten feet long. Insert one end of the string through the hole in the bottom of one can. Make a knot on the inside of the can so that the string cannot pull out. Repeat with the other can. Have two children each take one of the cans and stand ten feet apart, keeping the string taut. One person may talk into the can while the other can hear him by placing the can near his ear.

L.A.P. ONE
MAN'S NEED FOR ENERGY



As long as man has lived on the earth, he has needed energy. He has needed energy in his own body in order to walk, run, jump, eat, find or grow food, build himself a shelter, and protect himself from danger. For this biological energy he must compete with other animals and plants.

As time passed, man found he also needs other kinds of energy. He needs mechanical energy for machines to grow and harvest his crops. He needs to make goods at factories. He needs to travel from one place to another using cars or buses. He needs heat energy to cook his food and warm his home. He needs electrical energy for light at night, and to run appliances in his home. Can you think of any other things for which man needs energy? List them and discuss them with your class.

ACTIVITIES

You might like to do some of the following activities. They will help you understand how much energy is used today.

1. When you get home make a list of all the things in your own home or in your neighborhood for which energy is needed. Find as many as you can. Report what you find to your class.
2. Make a collage, using pictures from magazines, of things that need energy to work.
3. Write a story, such as "The Night the Lights Went Out," or "The Day All the Traffic Stopped". Try to show how much man has come to depend on energy and how helpless he may feel without it. You may want to present the story to your class as a play or a puppet show.
4. Make a list, or a collage of pictures from advertisements, of energy-using appliances and machines that man could most easily do without. Think of the things that are convenient to have, but not really necessary, such as an electric juicer for making fruit juice or an electric can opener. (Many people still use the hand-operated type.) Think of all the energy that could be conserved by eliminating the things that man does not really need!

L.A.P. ONE SIMPLE MACHINES

You have learned that man needs energy for the many kinds of work he does. Man has invented machines to make his work easier.

Did you know that you use machines everyday? Everywhere you go you carry a SIMPLE machine with you. Can you guess what it is?

There are six simple machines. These six machines are:

1. The Screw
2. The Lever
3. The Wedge
4. The Pulley
5. The Inclined Plane
6. The Wheel and Axle

These machines help you to do work. They can also go together to make a larger machine.

Have you figured out what machine you always have with you? Here's a hint. Pick up your book. Now set it down. You have just used a lever known as your arm. Now let's look at each machine.



The Screw

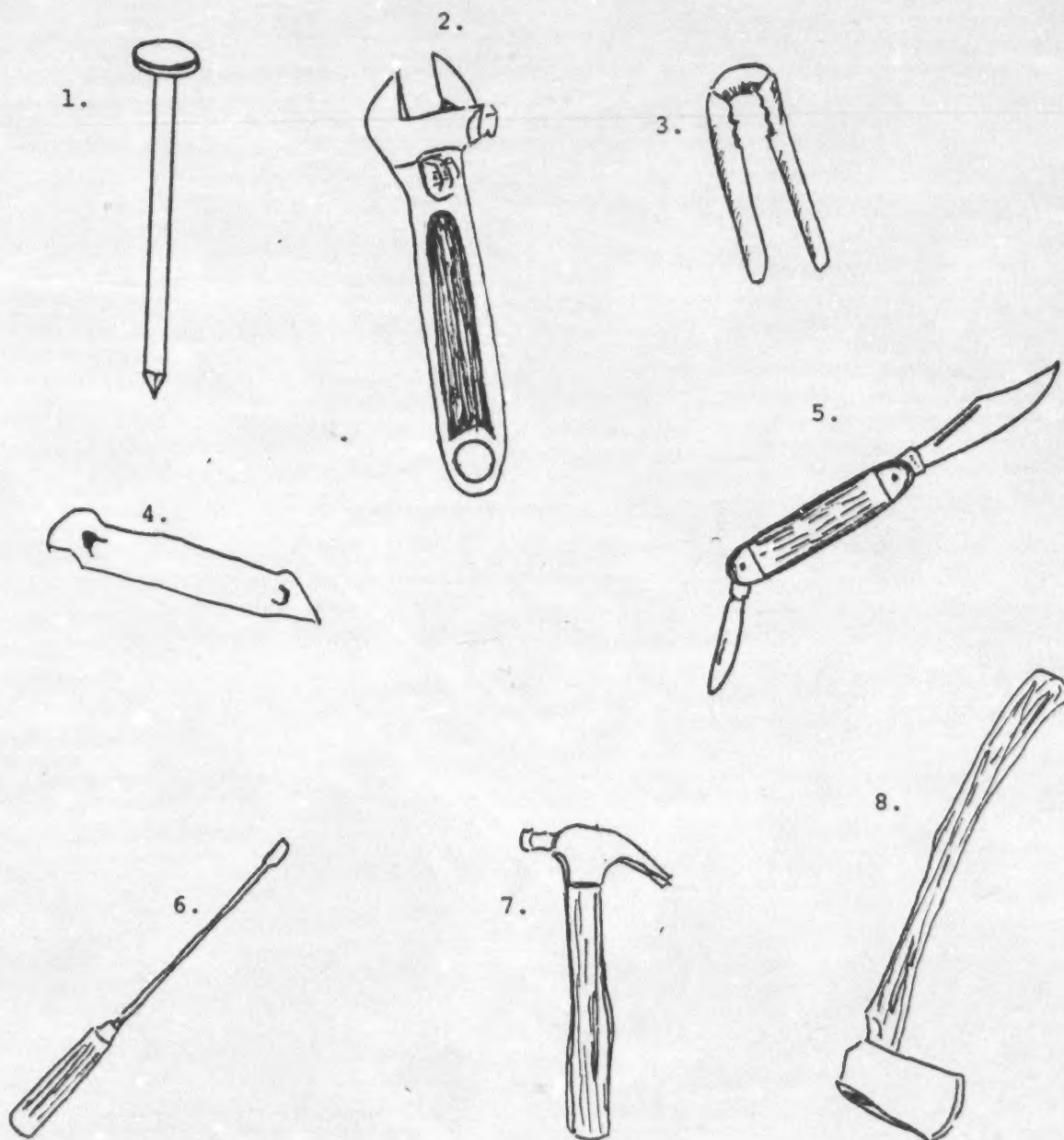
This is a special kind of inclined plane.

Activity: Cut a piece of paper into the shape of a triangle. The long side of your triangle is an inclined plane. Color this side red. Now, wind the paper around the pencil. The red lines are like a screw.

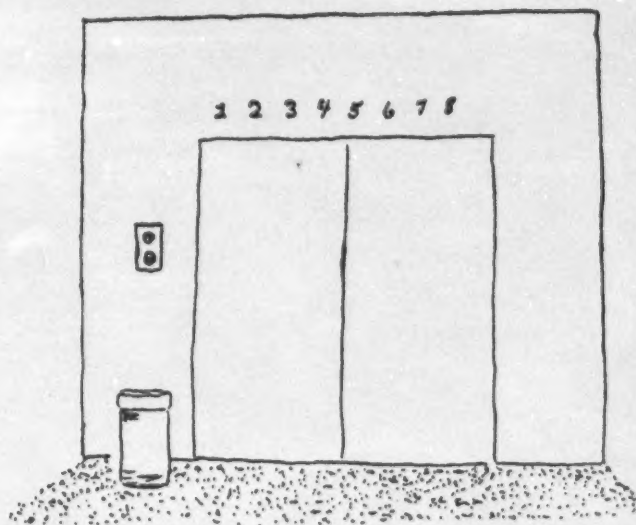
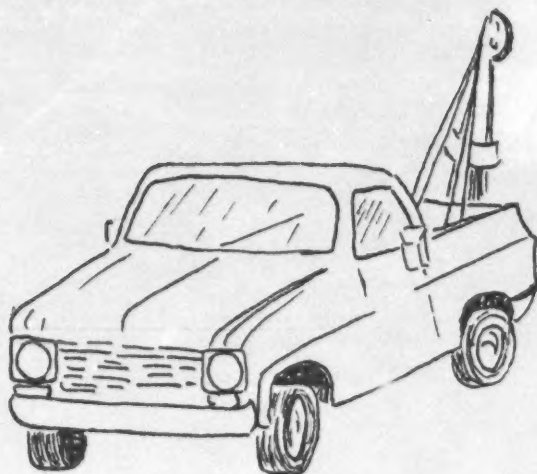
LEVERS AND WEDGES

Simple machines make work easier. LEVERS help you move or lift heavy objects. Wedges are specialized inclined planes. They split things apart or cut things.

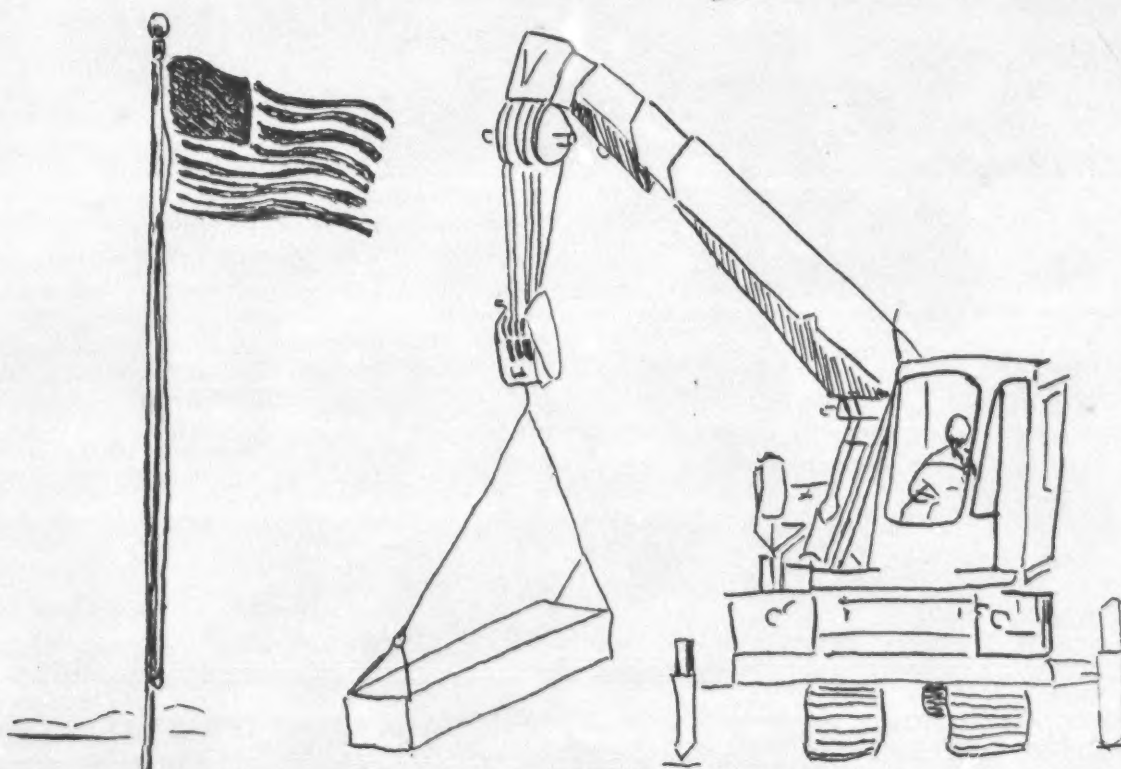
Put an "L" by the picture of a LEVER, and a "W" by the picture of a WEDGE.



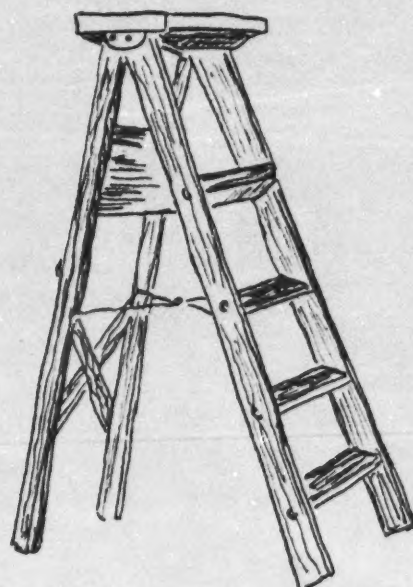
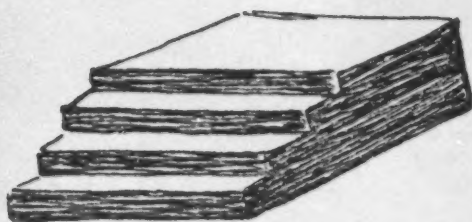
WHERE ARE PULLEYS USED?



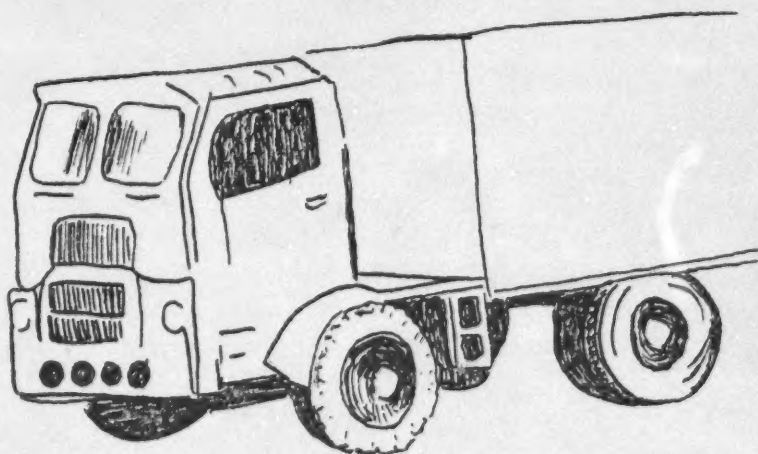
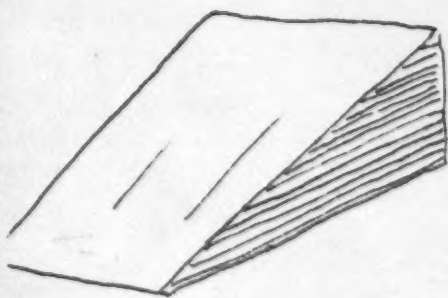
A pulley is a wheel with a groove in it. A rope or cable fits into the groove. When you pull the rope, the pulley turns. A load on one end of the rope is moved. The pulley makes the load easier to move.



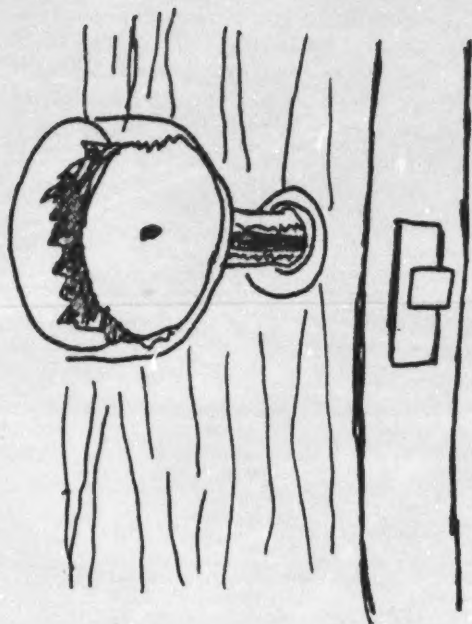
INCLINED PLANES



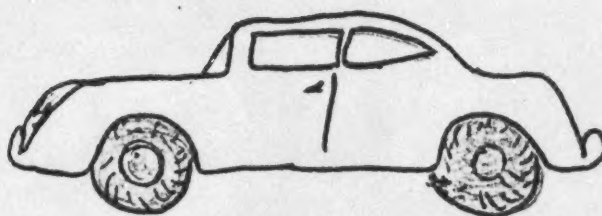
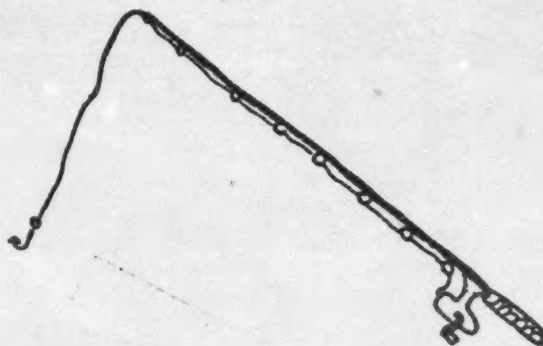
An inclined plane is a sloping surface.
It makes lifting heavy objects easier.



WHEELS AND AXLES



The wheel is part of a simple machine called the wheel and axle. Whenever you turn a door knob you are using a wheel and axle. The knob is the wheel. The rod is the axle. They work together to open the door. You can't have one without the other.



L.A.P. TWO
SIMPLE MACHINES
LAB ACTIVITY

Activity 1

Materials Needed:

Various hand tools (hammer, pliers, crow bar, screw driver, small axe, chisel, wrench, scissors, bumper jack, nut cracker, egg beater, bottle opener, pulleys, pencil sharpener.)

Group the hand tools according to the type of simple machines they are. Pictures of tools may be substituted for the actual tools.

Activity 2

Materials Needed:

Claw hammer, nails, board

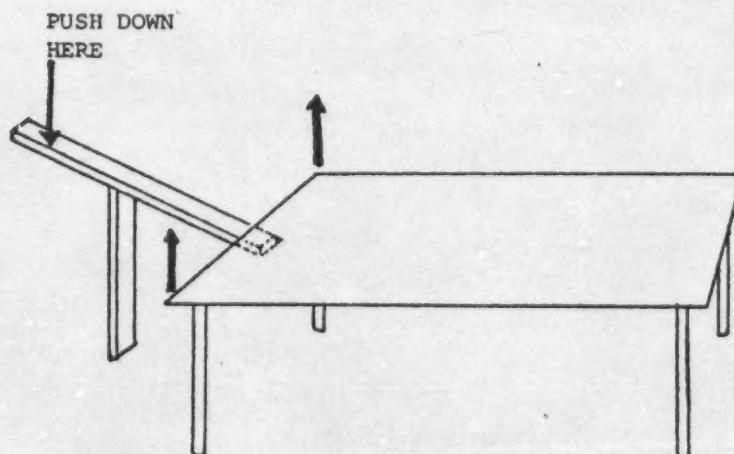
Drive a nail into a board so that the head extends above the surface of the board. You should attempt to pull the nail out of the board with your hand. Then remove the nail with the claw hammer. Which simple machine is the claw hammer? _____

Activity 3

Materials Needed:

Two boards the same length as the height of a table in the classroom.

Place one board on top of another with one end of the cross piece under the edge of table. Push down on end of cross piece. Move vertical piece closer and further away from table to find location where it is easiest to lift table. What machine is this? _____



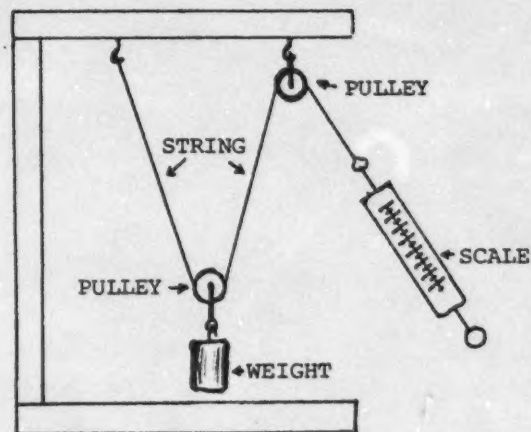
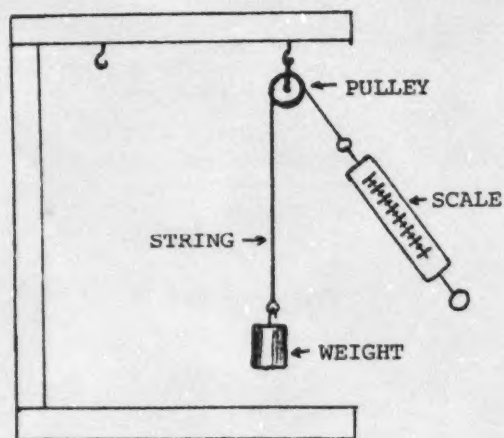
Activity 4

Materials Needed:

Frame to hang pulley on, pulleys, string or rope, scale, weight.

Hang pulley on frame, and attach weight to string. Thread string through pulley and attach scale to end of string. When you pull on scale you should measure the amount of force required to lift weight.

Lift weight a second time, but using a fixed pulley attached to the frame and a moveable pulley. Once again the force required to lift the weight should be measured. Was it easier to use one or two pulleys? _____



Activity 5

Materials Needed:

Pencil sharpener, string, weight.

Remove the cover from a pencil sharpener and tie a string tightly around the end of the shaft. Tie a weight to the end of the string and turn the handle. The pencil sharpener is used as a wheel and axle in this experiment. What part is the wheel? _____

What part is the axle? _____

Activity 6

Materials Needed:

Pencil sharpener with handle removed, pencil, pencil sharpener with handle.

Attempt to sharpen pencil with sharpener without handle and then use sharpener that has handle. Can a wheel and axle be used separately? _____
Why? _____

Activity 7

Materials Needed:

Screwdriver

Try to keep shank of screwdriver from turning while another student turns handle. The handle acts as a _____.

Activity 8

Materials Needed:

Two 7/16" wrenches, one 1/4" bolt and nut, one board with hole drilled in it.

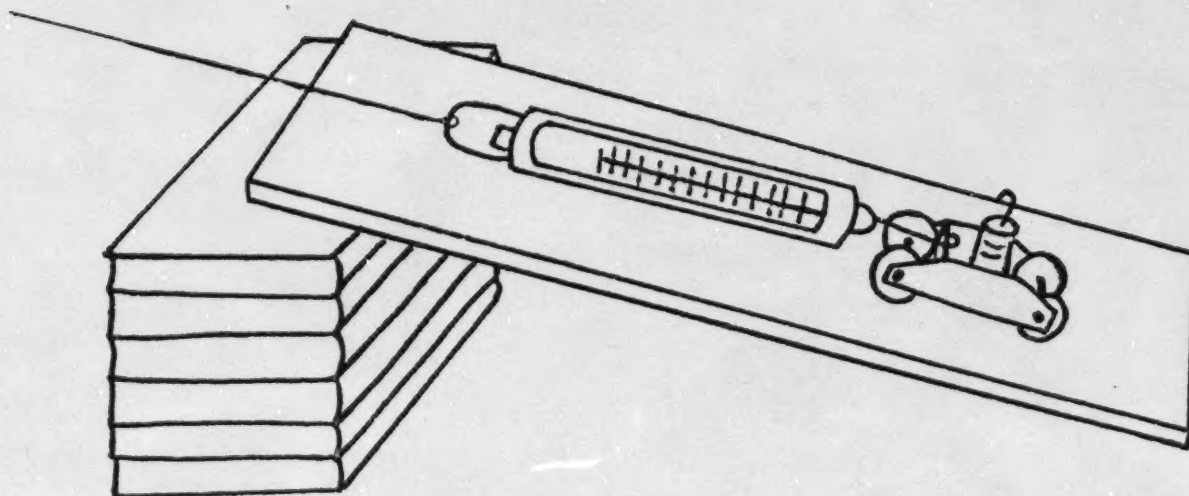
Put bolt through hole on board and tighten nut, then try to loosen nut without using wrench. Loosen nut using wrench to determine which method is easier. The wrench is acting as a _____.

Activity 9

Materials Needed:

Hall's Car, a weight, 2' board, 4' board, stack of books, scale.

Make an incline plane using the 2' board and stack of books. Place weight on roller skate, attach scale to skate and pull weight up board. Record force used to move weight. Replace the 2' board with the longer one. Once again, pull weight up inclined plane measuring force required. It took less F _____ to move the weight on the _____ foot inclined plane.



L.A.P. ONE ENERGY SURVEY

REVIEW: Energy is the ability to do W _____.
Energy is needed for a person to work, play, eat and to do any type of activity. It is also needed for plants and animals to grow. We must have energy in another form to turn on lights, make the television work, even to run a car or an airplane. Energy plays a very important part in our everyday life.



There are two states of energy - KINETIC (energy in motion) and POTENTIAL (stored energy).

K _____ energy or energy in motion occurs when a child is running or when water is coming down a waterfall. In these examples, the energy is moving.

Potential or S _____ energy is the energy a stone has when it is ready to fall down a hill. This energy is not moving. Another example of stored energy is oil or coal that is still in the earth. Gas in a gas pump is stored energy ready to become energy in motion when it is used to make an engine run.

ACTIVITIES

1. For 15 minutes keep a record of all energy in motion you see, including the energy your body is using.
(Example: breathing, writing, etc.)
2. Make a picture showing the two different types of energy.
3. Fold a sheet of paper in half. On one side list all the stored energy you can think of. On the other side list all the energy in motion you can think of.
4. Learn to spell and be able to give examples of the seven forms of energy - - - MECHANICAL, ELECTRICAL, ATOMIC, HEAT, LIGHT, CHEMICAL AND SOUND.
5. Match the following:

a. The most important source of energy	Insulation
b. A major gas user	Appliances
c. Prevents loss of heat	Sun
d. Uses a lot of electricity	Car
6. Can you think of any other ways to illustrate different forms of energy? If you can, do it and surprise your teacher and the class.

L.A.P TWO MAN'S EARLY USE OF ENERGY

The Indians and the Europeanas have always used energy. Both used the sun and human muscle power as their main energy sources. Indians and Europeans got their energy for human muscle power by eating food. The energy to grow the food came from the sun. But the Indians didn't use much energy. They only used enough energy to survive.



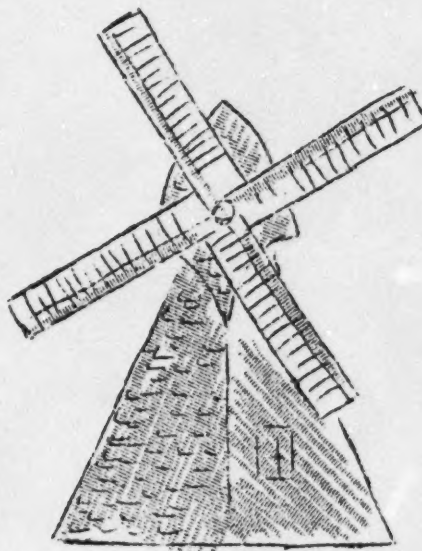
Europeans used more energy. They, too, used energy for survival, but they also looked for ways machines could do their work.

Both Indians and Europeans used different kinds of energy. The Indians used energy from the sun to grow their crops and to feed the animals they killed for food. Indians also used chemical energy. For example, they used heat given off by fire to cook their food and to warm themselves. Some tribes used fire to bake their pottery. Mechanical energy was produced by the Indians through human muscle power. The Indians used their muscle power to grow crops, to pick roots, to cut bows, to chip stones into arrowheads, to carve canoes and oars, to hunt animals, and to make adobe huts or tepees.

The Europeans used some forms of energy in the same way as the Indians. Europeans grew their crops and fed the animals they used for food with energy from the sun. They used chemical energy from fire to cook their food and warm themselves. But the Europeans used more energy and in a way not known to the Indians. Using chemical energy from fire, Europeans formed tools of metal. With these metal tools the Europeans built machines.

The metal tools of the Europeans were simple at first. One such simple tool was the plow. When the plow was pulled by animals, such as horses and oxen, man's life became a little easier.

As the Europeans talked with each other and with people of other countries, they came up with new ways to use energy. For instance, windmills were introduced into Europe in the 10th century. These machines produced mechanical energy that helped Europeans grind their grain and pump water. The Europeans used the wind to sail their boats. This movement by boats produced mechanical energy.



Water wheels were used by the Greeks as early as 85 B.C. to produce mechanical energy. Later, Europeans found that when water was heated to a boiling point, it produced steam. By the 17th century, a man named Newcomen built a low pressure steam engine to pump water out of mines. In Newcomen's machine, coal produced the chemical energy needed to heat the water to steam.

In conclusion, the Indians used less energy than Europeans because they used only what they needed to survive. Indians were happy with their way of life. They did not need to make machines.

Although the Europeans used the same forms of energy as the Indians, they used more energy. Europeans used energy to make machines do work for them; their way of life required machines.

TECHNOLOGY - GUILTY OR NOT GUILTY?

The following trial did not really take place. It is fiction. Maybe it should happen. The trial looks at the good and bad uses of energy. On the one hand, Indians say that Europeans are destroying the Earth. The Europeans feel they are improving life for all people. Read the trial and see what you think.

TRIAL

Trial members are the judge, the plaintiff (the complaining parts), the defendant (the party against whom the action is brought), the plaintiff's lawyer, the defendant's lawyer, 12 jurors (6 European-Americans and 6 American Indians). The case involves the American-Indian versus the European-Americans on a violation of the use of energy. The time is 1850.



JUDGE: "Here ye, hear ye, this court will now come to order. The jurors are not to let their feelings get in the way of a just decision. You are to listen to the facts and base your verdict on them."

PLAIN- "Your honor, I wish to call upon Chief Sunrise, who
TIFFS will speak for the Indians of this country." (Chief
LAWYER: Sunrise is sworn in.)

CHIEF "Your honor, my people are here today to protest the
SUNRISE: overuse of energy by the people who came to America from Europe. The white man cuts down trees to build houses and to plow the land for his crops. This uses much wood. But the white man does not stop and use what is necessary to live. He only needs fire to

cook his food and to warm himself. He goes beyond that to make weapons which he uses to kill too many buffalo and also the Indians. He makes tools such as the plow to do his work for him. Now he is beginning to use fire to heat water to steam and run his machines. The white man is using too many of our natural resources. My people want them to use less energy so there will be some left for our children."

JUDGE: "Thank you. You may step down, Chief Sunrise."

DEFEN- "Your honor, I wish to call upon Senator Carpenter,
DANTS who will represent the European-American."

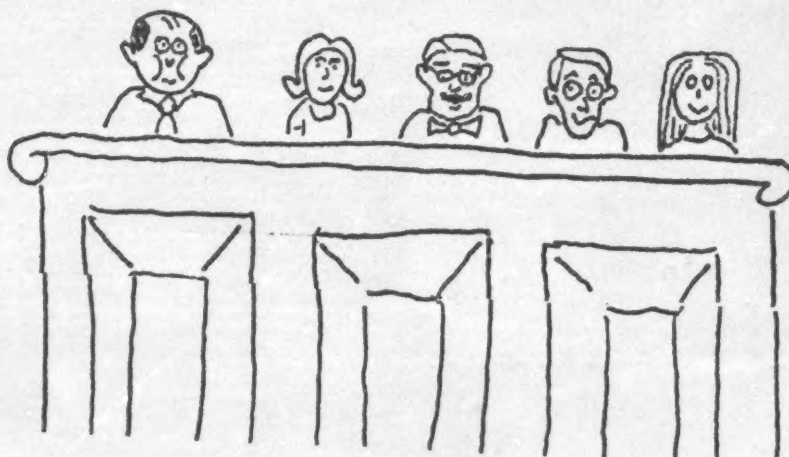
LAWYER: (Senator Carpenter is sworn in.)

DEFEN- "Your honor, I wish to inform the jury that the
DANT: energy we use is necessary for our way of life. Our people are not using any form of energy that the Indians are not using. Even steam is heat energy. There is more than enough wood because there is a great deal of unsettled land with many trees. Because we are finding so many energy sources, it does not matter how much energy we use. There is enough energy for the Indian's children and ours for thousands of years to come. After all, why did God put all this energy here if he did not mean for us to use it?"



PLAIN- (The lawyer's final address).
 TIFFS' "Members of the jury. More and more people are
 LAWYER: coming to this land each year, tearing down
 energy resources. These energy resources such
 as trees are not being replaced as fast as they
 are taken and we will run short sooner than you
 think. All the wood that the European-Americans
 use is causing more damage than just overuse.
 The acres stripped of trees are eroding and the
 top soil is washed away. This not only leaves
 the soil no good for crops, but the soil that is
 washed away is polluting our streams and killing
 fish and wild life."

DEFEN- (His final address).
 DANTS' "Members of the jury, there is enough energy for
 LAWYER: all. The trees will grow back. The soil can be
 fertilized. We are finding more and more forms
 of energy every year. If we ever start to run
 out, we will think of a new way to produce energy.
 There is no need to cut down."



Here the jury dismisses to discuss the case. (The rest of the class can break up into discussion groups to see if their verdict is the same as that of the jury.)

POSSIBLE SOLUTIONS:

Statute of limitations, which means that a case must be filed within a certain time limit. The Indians should have brought the case to court right after the Europeans got here, instead of waiting until the European had changed his way of life to the point where it was hard for him to go back to more primitive ways.

Lack of evidence.

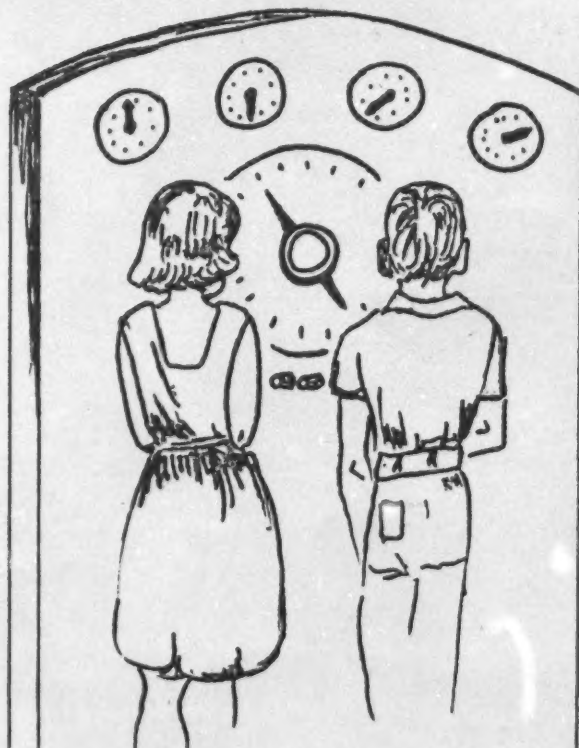
Transfer the case to a higher court.

L.A.P. TWO
HOW THE INDUSTRIAL REVOLUTION AFFECTED
MAN'S USE OF ENERGY

The period of time when the Europeans were inventing so many machines is called THE INDUSTRIAL REVOLUTION. A revolution can be many things. It is mostly a change in something. The American Revolution was a change in government. A bicycle tire makes a revolution when it turns or changes position. The Industrial Revolution was a slow changing of machinery. People changed from using hand tools or animals to large machines. With this in mind, read the play and learn more about the I _____ R _____.

A PLAY:
THE INDUSTRIAL REVOLUTION

(As the play opens two children, a boy and a girl, are standing before a Time Machine.)



KEN:

"I wonder where the Time Machine will take us this time?"

SUE:

"I don't know. I hope it's an interesting time and place. We sure have been learning a lot about the world and its history!"

KEN:

"C'mon! Let's go!"

(The children turn dials and push buttons on the machine and crawl inside. The stage is darkened or the curtain closed. Strange loud music - or sounds- are heard. When the stage is visible again, the children come out of the machine to find a large crowd of people talking to each other in excited voices. They approach an old woman standing nearby.)

SUE:

"What's all the excitement about? What's happening?"

WOMAN:

"Don't you know? It's the Industrial Revolution. Say! Where did you come from? You weren't here a second ago. What kind of clothes are you wearing? I've never seen the likes of them before!"

KEN:

"Well, it's kind of hard to explain. We have been travelling in a Time Machine to different times in history to find out what has happened in the world. What year is this, anyway?"

WOMAN:

"This is 1850. Well, your story certainly sounds strange, but with the changes I've seen in my lifetime, I'm ready to believe anything."

SUE:

"Tell us about the Industrial Revolution. What is it?"



WOMAN:

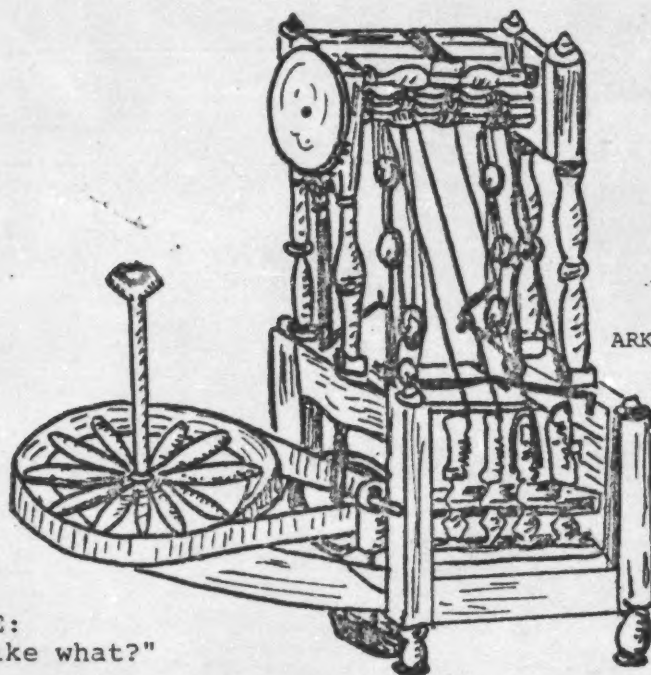
"Well, it all began in Great Britain around 1750, about a hundred years ago. It moved here to the United States around 1790. The Industrial Revolution is the change from doing work by hand to doing it by machine. The making of goods has moved from the home into factories. Many people are working in the factories where goods can be made faster and cheaper."

KEN:

"What caused the Industrial Revolution?"

WOMAN:

"The invention of some wonderful machines and the discovery of new sources of power, which comes from energy."



ARKWRIGHT'S SPINNING MACHINE

SUE:

"Like what?"

(An old man who has been overhearing the conversation moves closer and speaks.)

MAN:

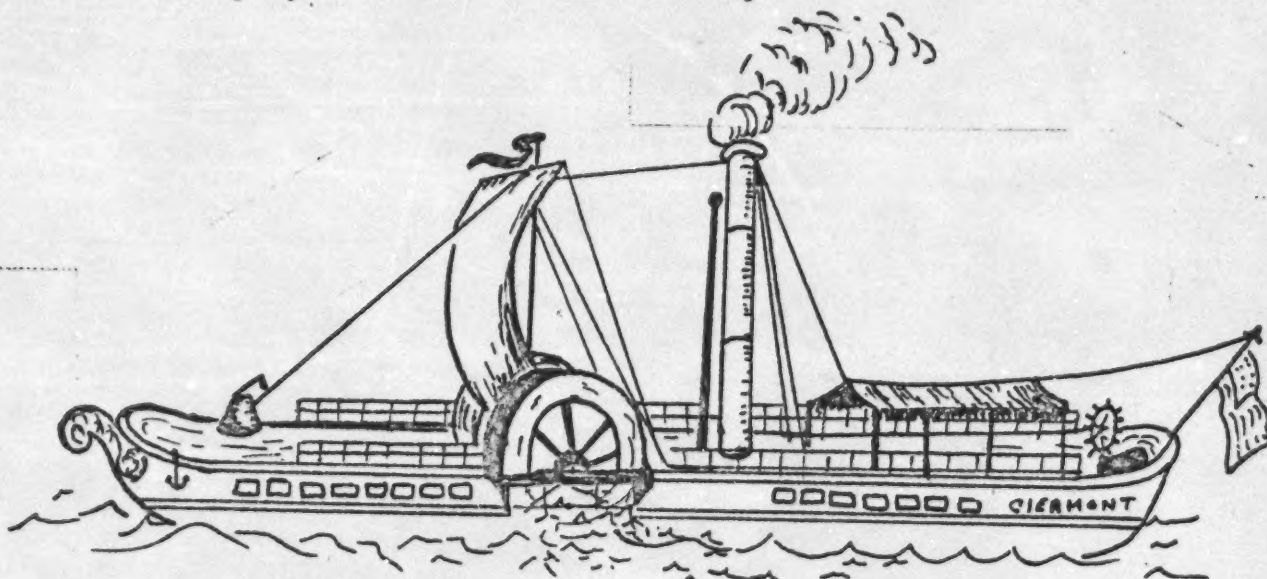
"I can answer that. Here are some examples. The invention of the power loom in 1814 made it possible to spin and weave cloth in a factory. Elias Howe invented the sewing machine in 1846, and that changed the clothing, shoe, and leather industries. One of Eli Whitney's inventions is the idea of having machine parts that can be interchanged. If one part wears out or breaks, a new part can easily be put in and the machine will be perfect again. Right now, William Kelly and others are working on new and improved ways of making steel from iron ore, so better machinery can be made."

KEN:
"I see!"

SUE:
"What about sources of power?"

MAN:
"Well, of course, the most important change of this Industrial Revolution was the use of mechanical energy in place of human energy in the making of goods. We still need people to run the machines. But, as the Industrial Revolution continued, there have been changes in sources of power for the machines. For instance, the earlier factories used water power and had to be built along streams and rivers. Now, we've developed steam power, so we don't have to have the running water."

WOMAN:
"Robert Fulton built the first successful steam-powered boat in 1807, and, since then, hundreds of steamboats have traveled the Mississippi and Ohio Rivers and their tributaries, carrying much of the nation's freight."



KEN:
"Are there other kinds of transportation run by steam?"

MAN:
"Oh, yes! A very important one is the steam locomotive. The Baltimore and Ohio Railroad began running in 1830, with its' coaches pulled by horses, but in 1831, Peter Cooper's steam locomotive, the Tom Thumb, made a successful trip and soon replaced the horse. Railroads are the fastest and most convenient form of transportation today."

WOMAN:

"Right now, the British are improving an ocean-going iron steamer, which will replace the American Clipper ship."

SUE:

"Hey! I just thought of another invention. Samuel Morse invented the electric telegraph in 1844."

MAN:

"That's right. Telegraph lines are being strung out all over the country. That's another great invention."

WOMAN:

"What I wonder about is how long the Industrial Revolution will last."

KEN:

"We can answer that for you, or at least, we can tell you that it's still going on in 1979. People are still trying out new inventions and looking for new sources of energy."

MAN AND WOMAN:

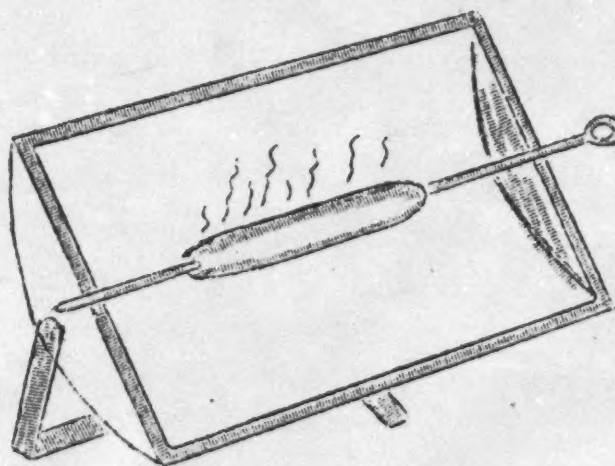
"Really!"

SUE:

"That's right, and many changes have been made since 1850. From about 1890 to 1940, coal replaced wood as the leading source of fuel. In 1975, we used more oil and gas than coal. All three are fossil fuels."

KEN:

"Steam power began to be replaced by electric power in the early 1900's and now, electricity is the main source of power in homes and factories. Atomic and solar energy are being developed and will be more and more important in the future."



WOMAN:

"You use energy in your homes!"

SUE:

"Oh, yes. We have many wonderful inventions which are used right in the home."

KEN:

"Why don't you come back with us and we will show you."

MAN AND WOMAN:

"All right!"

(They all get into the Time Machine, after Ken and Sue have the dials and buttons set.)

KEN AND SUE:

"Here we go!"

Cartoon removed due

to copyright restrictions.

ACTIVITIES

1. Pick out one of the following inventors and report to the class about his contribution to the Industrial Revolution:

Elias Howe	John Deere	Eli Whitney
Cyrus McCormick	Samuel Slater	William Kelly
Samuel Morse	Peter Cooper	Cyrus Field
Robert Fulton	Frances Lowell	Thomas A. Edison

2. Make a list of things that Ken and Sue can show to the man and woman from 1850. What new forms of transportation have been invented? What other means of communication have been added since the telegraph? How are our homes different from theirs? You might write a play or story about their trip to 1976.
3. Make a collage of pictures or things that show forms of transportation at the present time.

L.A.P. TWO
SPELLING BEE

Here is a list of energy words to study for a class spelling bee. To help you learn them, unscramble those given on the right from the list on the left:

atomic	1. dowo _____
coal	2. sga _____
electrical	3. alsro _____
energy	4. uns _____
fire	5. kowr _____
gas	6. etha _____
gravity	7. aclo _____
heat	8. lio _____
kinetic	9. erif _____
light	10. glith _____
mechanical	11. woerp _____
moving	12. tenlopati _____
oil	13. srtedo _____
potential	14. motcai _____
power	15. ticniek _____
solar	16. calilecter _____
stored	17. nachmiclea _____
sun	18. vtagiry _____
wood	19. vignmo _____
work	20. gyneer _____

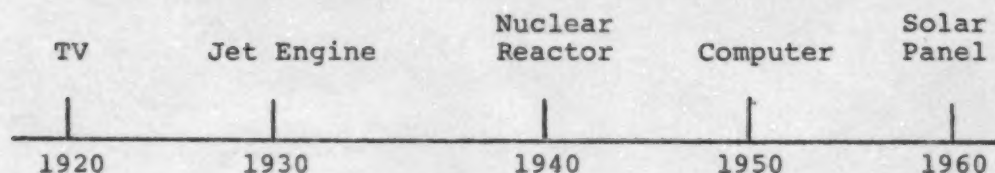
L.A.P. TWO TIME LINE

A time line is a line which represents the passing of time. You draw a long line and divide it into equal units of time (days, months, years, decades, centuries) by putting a word or number below the line. At each time period you put a picture above the line which shows what was happening or what existed at that particular time.

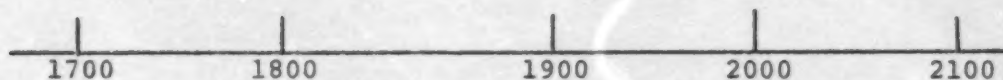
For this time line, you will show the use of energy in the world at different times in its history. You may do this by yourself, in a group, or with several groups in the class working on different parts of one large time line.

Below are some examples of time lines without pictures:

INVENTIONS



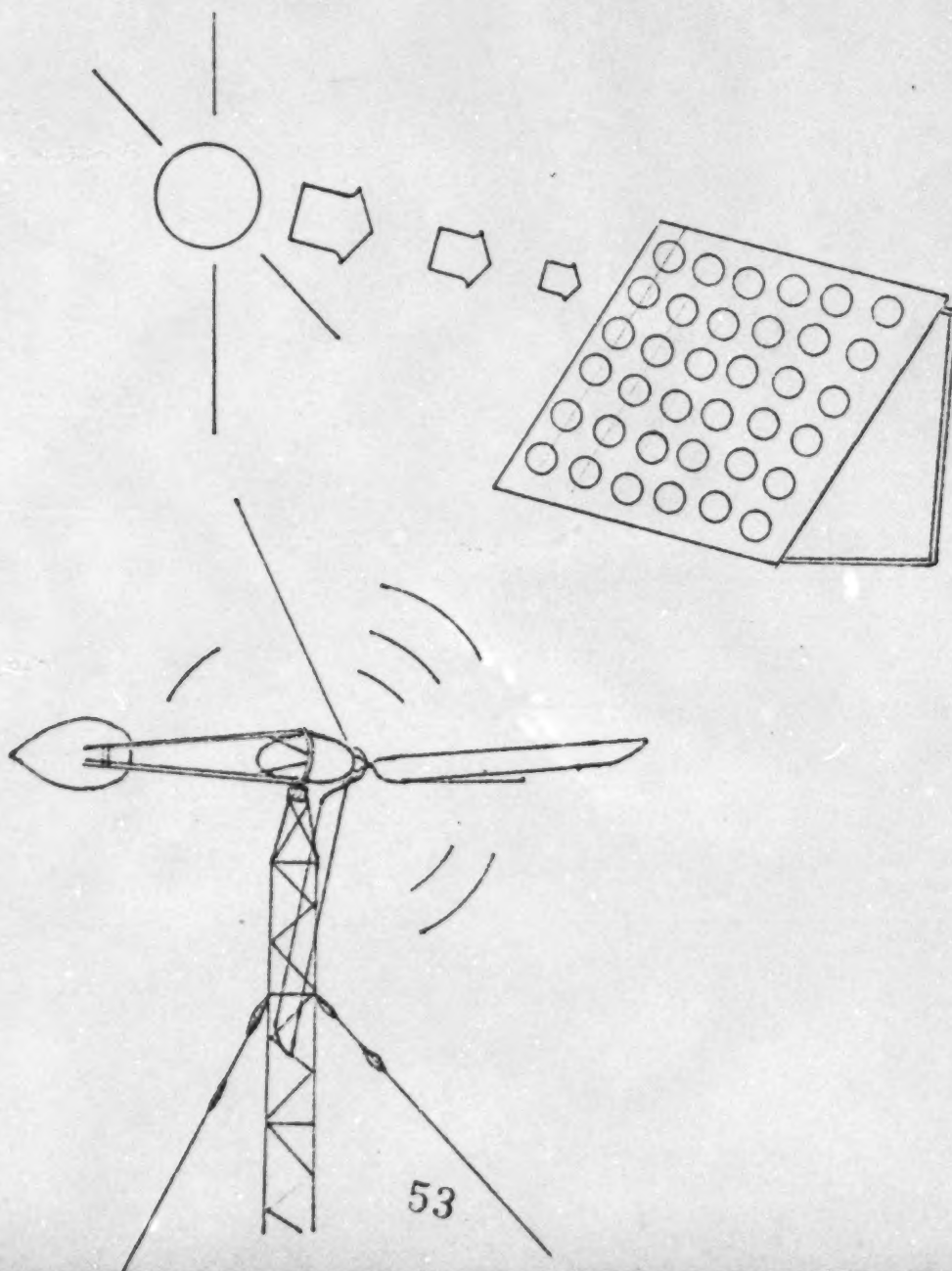
TYPE OF POWER



L.A.P. TWO
FILMSTRIP #3

You have learned about man's early use of energy. What about his future? Your teacher will be showing you a filmstrip called Harnessing New Sources of Energy. Can you think of any possible new sources of energy?

As you watch the film notice the new sources of energy that are mentioned. Be able to describe some of them. Notice some of the advantages and disadvantages of each.

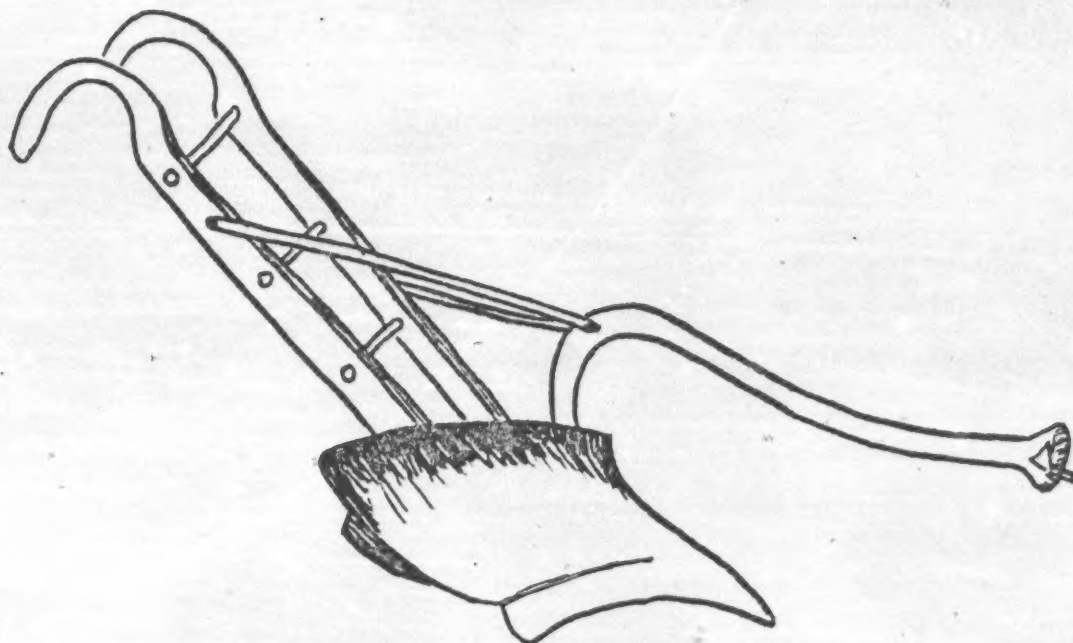


L.A.P. TWO
CAREER IDENTIFICATION EXERCISE

You have been learning about the nature of energy and its forms. The use of energy has changed from early times to the present. Energy is what we use to do our work. We can say that man's jobs have changed as energy production grew. Now we will look at the different kinds of jobs man has done since he learned to use energy.

What is a job? It is doing some kind of work. Today, we are paid money for the work we do. With that money we buy the food, clothes, and housing we need to live. You need a job so that you can live. What were the jobs cave people had? They didn't have any, did you say? Well, you're partly right. People a long time ago didn't have jobs or money like we do today. Their work was simply to gather food by hunting, fishing or just picking fruit and berries. Their work gave them the things they needed to live just like our work does.





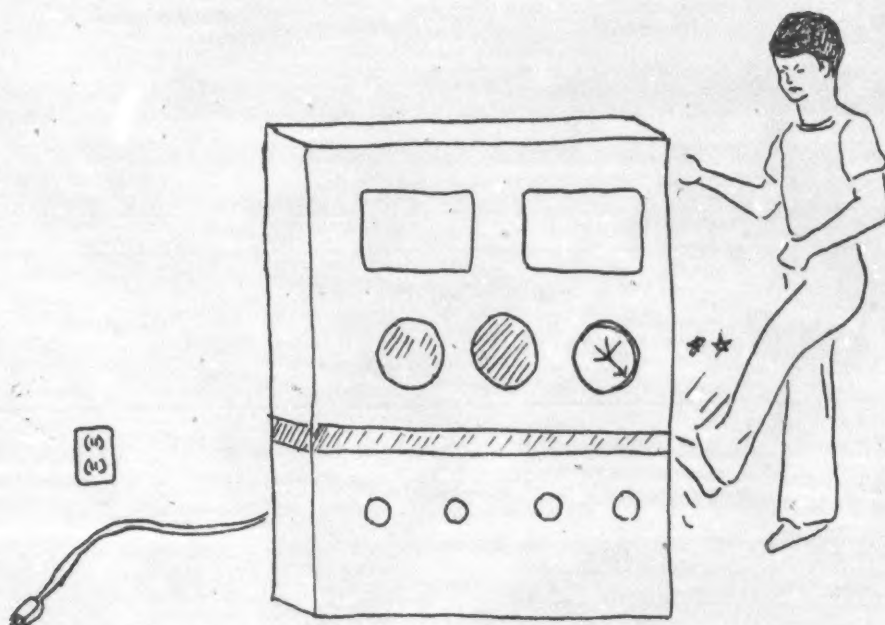
Slowly at first men found better ways of getting food. They began to use clubs or spears. Then someone invented a bow and arrow. Men learned to use these simple machines to help them do work. They learned how to plant things, at first by hand. They then discovered tools to use for planting crops. One of the most important tools they discovered was the PLOW. Now, man could do much more work and at a faster speed. Someone became better at making plows, so he only made plows. He traded plows for the things he needed to live. Man learned to barter (trade) for the goods he needed.

From this start man improved on all his tools and simple machines. Men did special kinds of work. Some just built homes, or fished, or made tools. These activities were the first kind of JOBS.

Men learned to use precious stones as money to pay for what they needed. Clothes, homes and food became more abundant. Still, men used their own hands to do their jobs. A clothes maker had no sewing machine to do his stitches. A carpenter had no electric saw to cut his wood. A mother had no stove to cook her food.



Not until the INDUSTRIAL REVOLUTION did men learn how to use the energy of steam to do work. After they did, one machine led to another. Men used steam for boats, trains, and other machines. The first factories began to grow. The demand for more goods from more people made men search even harder for ways to get more work done. Gas and electricity were the answers. Gas energy ran the machine that heated homes and ran engines. Oil was drilled and used as fuel. Then, electricity was harnessed. Now, man could work day and night because of the light bulb. Electric energy could do more work and faster than any other type of energy. People made machines that used electric energy for all kinds of work. Plants that produced the electricity popped up.



So today men have many different kinds of jobs to choose from. See if you can think of some of the jobs we have today that didn't exist before the Industrial Revolution.

EXERCISE:

List five (5) jobs you could have done before the Industrial Revolution.

L.A.P. TWO
ENERGY AND MAN'S PROGRESS
Value Exercise

Energy is what makes things go!
It not only moves them
but also makes them grow.

We need food, that's where our energy is found,
It comes from plants and animals,
Which are all around.

Energy helps us work, rest and even run,
We get it from our food,
And our food gets it from the sun.

Dr. Ed Steiner

Plants, animals and people are always using the flow of energy from nature. Man has learned how to catch it, and change it into different forms of energy. We have read how man learned from early times to the present to use energy to reshape the world. What we didn't know until a few years ago was the cost. Today we have POLLUTION of air, water and land. Not only that, we are using up our energy sources. Gas, oil and coal run the cars, homes and factories, but there is only a limited supply of these fuels.

We have learned about these problems. Now we are finding out how to solve these problems. How? By ENVIRONMENTAL AND ENERGY CONSERVATION.

What is CONSERVATION? It is learning how to SAVE nature and its' resources. It means having people use less energy. People should at least slow down on what we now use. There are three ways we can SAVE energy.

1. Making more efficient machines. This means getting more work from the same energy - more miles per gallon.
2. Using different conversion machines. Your body is a good conversion machine. It can save energy by doing things machines now do.
3. Limiting use. This is the hardest one. It means cutting down on power. Turn off lights when not in use. Buy smaller cars. Don't leave the refrigerator door open.

We know now what we must do to CONSERVE our energy and environment.

REMEMBER: BE NATURAL AND SAVE ENERGY!

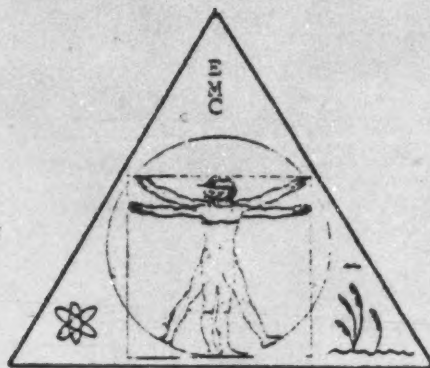
EXERCISE:

- A. Make a list of three (3) items you can think of to save energy under the three step definition of energy conservation.

1. Efficient Machines
2. Conversion Machines
3. Limiting Use

- B. Did you find it hard to decide what things to do to "LIMIT USE" of energy?

If you said yes, don't feel alone. Why?



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